(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 440 400 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91300633.4**

(51) Int. Cl.5: **F28F 9/00, B60K 11/04**

(22) Date of filing: **28.01.91**

(30) Priority: **01.02.90 JP 23034/90**

(43) Date of publication of application:
07.08.91 Bulletin 91/32

(84) Designated Contracting States:
AT DE FR GB IT SE

(71) Applicant: **SHOWA ALUMINUM KABUSHIKI KAISHA**
224-banchi Kaizancho 6-cho
Sakaishi Osaka(JP)

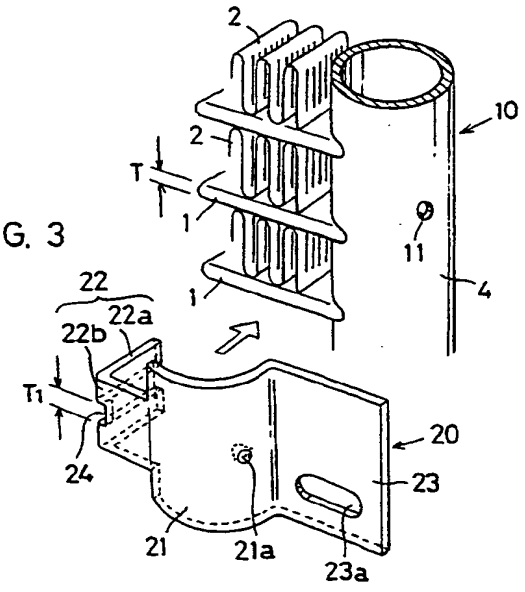
(72) Inventor: **Suzuki, Katsuhisa**
6-16, Nishi-2chome
Utsunomiyashi, Tochigi(JP)
Inventor: **Tokutake, Toshinori**
6-5-23, Jyoto
Oyamashi, Tochigi(JP)

(74) Representative: **Kerr, Simonne June et al**
European Patent Attorney POTTS, KERR & CO. P.O. Box 688
Ascot Berkshire SL5 8YT(GB)

(54) Heat exchanger.

(57) A heat exchanger includes a heat exchanger body (10) and fasteners (20) used to mount the body on an automobile or the like. The heat exchanger body comprises flat tubes (1) and fin members (2) alternatingly stacked one upon the other and a pair of hollow headers (3 and 4) with ends of each tube being connected to the headers in fluid communication with them. Each fastener (20) comprises a contacting concave portion (21) of a shape fitting on outer peripheral surface of each header, a hooking portion (22) protruding from an end of the concave portion, and a fastening portion (23) extending outwardly from another end of the concave portion. The concave portion (21) is placed in close contact with the peripheral surface of the header (3, 4) with a bent-up hook of the hooking portion (22a) being inserted in between two adjacent tubes so that the fasteners are soldered to the heat exchanger body so as to become integral with it.

FIG. 3



EP 0 440 400 A1

The invention relates to a heat exchanger of the so-called header type adapted for use as a condenser in car coolers or the like.

There have been used the serpentine type heat exchangers as the condensers in the automobile air conditioners or the like. The serpentine type heat exchangers comprise a flat extruded tube called "harmonica tube" and perforated longitudinally, which tube is repeatedly bent to assume a serpentine shape as a whole. Fin members are each interposed between two adjacent portions constituting the flat extruded tube and standing parallel with each other. A new header type of the heat exchangers, which is deemed epoch-making, has also been offered to take the place of the serpentine type in said field. In the header type heat exchangers a plurality of flat depressed tubes and corrugated fin members are stacked one on another or side by side in an alternating manner. Respective ends of each tube are connected to cylindrical hollow headers.

To mount the header type heat exchanger on the automobile body or the like, pieces of channel metal which is U-shaped in cross section have been employed as disclosed in Japanese Utility Model Kokai No. 64-38481. A pair of the channel pieces are fitted on the header so that their facing portions are fastened to each other for instance by means of bolts or the like. One of the paired channel pieces has a lug adapted to be secured to the automobile body. It is noted that such fastening members have necessitated intricate operations which cause a lowered labour efficiency in mounting the heat exchangers, in addition to the problem of increased weight of the heat exchanger inclusive of the fastening members. It may be proposed to use, in place of the prior art fasteners, a certain type of improved fastener which is arc-shaped at its one end and comprises at its other end a setting portion secured to the automobile body. The arc-shaped end may be fitted on the periphery of header so as to be attached thereto by the welding or soldering process. However, the positioning of such proposed fasteners will not necessarily be easy but require some tools to temporarily hold them in place while they are welded or soldered. It is possible that the welding gives rise to coolant leakage at places where the headers are soldered to the tubes. In a case wherein the proposed fasteners are soldered within an oven together with the headers and tubes in one operation, the tools for temporarily setting the fasteners will absorb heat to thereby make imperfect the soldering.

An object of the invention which was made to resolve the abovementioned problems is to provide a heat exchanger comprising fasteners to be attached to a heat exchanger body, the fasteners capable of being easily positioned precisely relative to the heat exchanger body into their self-setting state without needing any auxiliary setting members.

To achieve the object, the fasteners each comprise a contacting concave portion of a shape fitting on outer peripheral surface of a header of heat exchanger body, an L-shaped hooking portion protruding from an end of the concave portion and having a bent-up hook at an extremity of the hooking portion, and a fastening portion extending outwardly from another end of the concave portion, wherein the contacting concave portion is placed in close contact with the peripheral surface of the header, with the bent-up hook inserted in between two adjacent tubes so that the fasteners are soldered to the heat exchanger body so as to become integral therewith.

To attach the fasteners to the heat exchanger body, the concave portion of each fastener need be brought into close contact with the periphery of the header, and the bent-up hook of the hooking portion need be inserted into a gap between the adjacent tubes. In this temporary assembly, the hooking portion serves to precisely position the fastener relative to the heat exchanger body, and at the same time co-operates with the concave portion to securely hold the fastener on said heat exchanger body. Thus, such a self-setting state takes place spontaneously without employing any temporary setting means.

It will now be apparent that the fastener in the invention is soldered to be integral with the heat exchanger body wherein the concave portion rests on the periphery of header, with the hook of the hooking portion being inserted in the gap between the tubes. Therefore, the fasteners can be positioned and attached easily and precisely to the heat exchanger body, relying on particular tubes' ordinal numbers counted for example from the uppermost tube. In other words, the structure in the invention makes it possible to utilize as markings the accurate and regular arrangement of tubes in order to dispose the hook of hooking portion at its correct position. Further, the L-shaped hooking portion and the contacting concave portion are so effective to hold in position the fastener that any temporary securing members need not be employed to keep the temporary assembly in its self-setting state. Owing to this feature, the operation for attaching the fasteners to the heat exchangers body become easier. In addition, the fasteners in the invention do not need any auxiliary parts such as screws or rivets which have been used with the prior art fasteners such as "embracing brackets". Consequently, the number of parts becomes much less to make easier the management of parts and also to make simpler the processes of assembling and manufacturing, thereby reducing the produc-

tion cost of the parts of heat exchangers. It is thus possible to manufacture with a higher efficiency the heat exchanger cheaper in price and lighter in weight. Moreover, here is eliminated the possibility that the welding of the abovementioned proposed fastener to the heat exchangers body would give rise to coolant leakage at places where the headers are soldered to the tubes in said heat exchanger body which has been previously manufactured by the soldering method. Also eliminated is the problem that, in a case wherein the proposed fasteners are soldered in one operation within the oven together with the headers and tubes, the tools for temporarily setting the fasteners would absorb heat to thereby make imperfect the soldering.

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which: -

Fig. 1 is a front elevation of a heat exchanger constructed according to the invention;

Fig. 2 is a left side elevation of the heat exchanger;

Fig. 3 is an exploded perspective view showing the heat exchanger body and a fastener;

Fig. 4 is an enlarged cross-section taken on the line IV-IV of Fig. 1;

Fig. 5 is a cross-section showing a modified fastener; and

Fig. 6 is a front elevation showing a further modified fastener which is attached to the heat exchanger body.

The invention will now be described in detail referring to its embodiments applied to a heat exchanger made of aluminum and adapted for use as a condenser.

The term "aluminum" in this specification is meant to include its alloys.

In Figs. 1 to 4, the reference numeral 1 denotes aluminum tubes which are in their horizontal position and stacked one above another. The reference numeral 2 denotes aluminum corrugated fin members, each of them being interposed between two adjacent tubes.

The tubes 1 are, for example, flat perforated tubes made by the extrusion method. Alternatively, they may be seam-welded flat tubes in which inner fins are inserted and secured.

The corrugated fin members 2 are of the same width as the tubes 1, and are soldered thereto to be integral therewith. To facilitate the soldering of the fin members to the tubes, it is preferred to employ the fin members which are made of a brazing sheet consisting of a core material having one or both sides covered with soldering agent layers.

The reference numerals 3 and 4 denote left and right hollow headers, respectively, which are circular in their cross sections. Ends of each tube 1 are connected to these headers so as to be in fluid communication therewith. It is also preferred, in order to facilitate the soldering of the tubes to the headers, to employ the headers 3 and 4 which are made of the brazing sheet consisting of core material having one or both sides covered with soldering agent layers. In such a case, the brazing sheet is bent at first to form a cylinder with a longitudinal slit, and then longitudinal abutting edges of the slit are soldered to each other to form a hollow aluminum pipe.

Top and bottom ends of each header 3 and 4 are closed with aluminum caps 5.

As shown in Fig 1, a coolant inlet pipe 6 is connected to an upper outer portion of the left header 3, with a coolant outlet pipe 7 connected to a lower outer portion of the right header 4. A partition 8 is fixed in the left header 3 at its central portion intermediate the top and bottom whereby the inside of the header 3 is divided into upper and lower spaces. Another partition 8 is secured in the right header 4 somewhat below its center between top and bottom. Coolant which flows through the inlet pipe 6 into the left header 3 will flow through all the coolant paths within the tubes which are arranged to form a serpentine passage as a whole. Air streams passing through air paths which are formed through the corrugated fin members 2 will effect heat exchange between the coolant and them so that the coolant is condensed before leaving the heat exchanger through the outlet pipe 7. The reference numeral 9 denotes top and bottom side plates which are disposed outside the outermost corrugated fin members.

A heat exchanger body 10 constructed as above will be mounted on an automobile body or the like by means of four fasteners 20 which are located respectively at left upper and lower portions as well as at right upper and lower portions of the heat exchanger body 10.

The fasteners 20 are each manufactured by bending a band of aluminum sheet, as shown in Fig. 3. A middle portion of the band is curved to fit on the outer peripheral surface of the headers 3 and 4, with one end of the band being bent up to assume an L-shape. Thus, each of the fasteners comprise a contacting concave portion 21 of a shape capable of fitting on outer peripheral surface of the headers 3 and 4, a hooking portion 22 L-shaped in cross section and protruding from an end of the concave portion 21, and a fastening portion 23 protruding from another end of the concave portion 21 so as to extend in radial direction thereof. The hooking portion 22 has at its extremity a bent-up hook 22a which is connected to the concave portion 21 by an extension 22b and comprises a cutout 24 adapted to engage with the tube, the cutout extending inwardly from a tip end of the

hook 22a and disposed centrally of the width of said hook. The width T_1 of cutout 24 is preferably the same as or larger than the thickness "T" of tubes by 1 mm or less so that the cutout 24 can grip the tube tightly not to become loose-jointed. On the other hand, the contacting concave portion 21 has an inwardly protruding lug 21a at a position corresponding to a locking aperture 11 which is perforated through a peripheral wall of each header 3 and 4. A bolt-inserting hold 23a is perforated through the fastening portion 23.

Before the fasteners 20 are soldered to the heat exchanger body 10, the contacting concave portion 21 is placed in close contact with the peripheral surface of the headers 3 and 4, with the inwardly protruding lug 21a being engaged with the locking aperture 11, and the cutout 24 of bent-up hook 22a thereby grips the tube 1. The hooking portion 22 is thus inserted in between two adjacent tubes 1, and the fasteners in this state are soldered to the heat exchanger body 10 and become integral therewith. It is desirable to conduct the soldering of fasteners in the so-called "in-one-operation" or "blanket" manner together with other parts of the heat exchanger body 10. In order to facilitate such "blanket" soldering, the headers 3, 4 and the corrugated fin members 2 are generally made of the material covered with soldering agent layers. It is to be noted that in the temporary assembly including the fasteners before the soldering, the fasteners 20 maintain their "self-setting" state relative to the heat exchanger body 10.

In general, a minimum clearance "M" is to be kept between the edges of fin member 2 and each header 3, 4 as shown in Fig. 4 during the "blanket" soldering of the heat exchanger body 10 within the oven. If the distance between said edges and the header is less than the minimum clearance "M", then a considerable amount of the soldering agent will flow away from the soldering points towards the fin members, thereby impairing the soldering of tubes 1 to the headers 3 and 4. Likewise, the bent-up hook 22a of each fastener 20 must be kept spaced apart from the headers 3 and 4 by at least the distance "H" which is equal to the minimum clearance "M" plus the fin pitch as shown in Fig. 4.

As described hereinbefore , the locking aperture 11 is formed through the wall of header 4 and correspondingly the inwardly protruding lug 21a protrudes from the concave portion 21 of fastener 20 so that said concave portion of fastener can be exactly placed on said header 4 in the embodiment described above. However, it will be understood that it is also possible to form the wall of header 4 with an outwardly protruding lug 12 and correspondingly to perforate a locking aperture 21b through the concave portion 21 of fastener 20, for the same purpose, as in a modified fastener 20 illustrated in Fig. 5.

Fig. 6 illustrates a further modified fastener 20 whose hook of the hooking portion 22 lacks the cutout, but other features are similar to those in the embodiment described above. The hook in this case is inserted between two adjacent tubes , and soldered to the heat exchanger body 10. The width P_1 of the hook is preferably the same as or less than the distance "P" between two adjacent tubes by at most about 1.5 mm so that the said modified fasteners can be tightly secured to the body 10 so as not to become loose-jointed. The same features as those in the already described embodiment are indicated by the same reference numerals and description thereof is omitted here.

Instead of bending one aluminum sheet, two or more aluminum pieces may be welded to form the fasteners in the embodiment. It is also possible to bend a belt-like aluminum sheet at its middle portion intermediate two longitudinal ends so as to form the concave portion fitting on the header, and to subsequently bend both ends in opposite directions to form the hooks of the hooking portions. In this case, a separate fastening piece will be welded to the concave portion so as to protrude outwardly thereof.

Claims

1. A heat exchanger comprising a heat exchanger body (10) and fasteners (20) attached thereto, the heat exchanger body (10) having flat tubes (1) and fin members (2) alternatingly stacked one upon the other and a pair of hollow headers (3 and 4) to which ends of each tube are connected in fluid communication therewith, characterized in that the fasteners (20) each comprise a contacting concave portion (21) of a shape fitting on outer peripheral surface of a header (3 or 4) of heat exchanger body (10) a hooking portion (22) protruding from an end of the concave portion (21) and having a bent-up hook (22a) at an extremity of the hooking portion (22), and a fastening portion (23) extending outwardly from another end of the concave portion (21), the contacting concave portion being placed in close contact with the peripheral surface of the header, with the bent-up hook (22a) inserted in between two adjacent tubes so that the fasteners are soldered to the heat exchanger body so as to become integral therewith.

2. A heat exchanger according to claim 1, characterized in that the bent-up hook (22a) of the hooking portion (22) of each fastener (20) is formed with a cutout (24) extending from tip end the hook so as to engage with the tube.

3. A heat exchanger according to claim 1, characterized in that the width of the bent-up hook (22a) of the hooking portion (22) of each fastener (20) is the same as or slightly less than a distance between the adjacent tubes.

4. A heat exchanger according to claim 1, 2 or 3, characterized in that the bent-up hook (22a) of the hooking portion (22) of each fastener (20) is inserted in between the adjacent tubes and spaced apart from the header (3 or 4).

5. A heat exchanger according to claim 1, characterized in that each fastener (20) comprises an inwardly protruding lug (21a) protrduing from the concave portion (21) of the fastener (20), and each header (3 or 4) has a locking aperture (21b) perforated through a peripheral wall of the header so that the locking aperture (21b) engages with the inwardly protruding lug (21a).

6. A heat exchanger according to claim 1, characterized in that each header (3, 4) comprises an outwardly protruding lug (12) protruding from a peripheral wall of the header and each fastener has a locking aperture (11) perforated through the concave portion of fastener so that the locking aperture engages with the outwardly protruding lug.

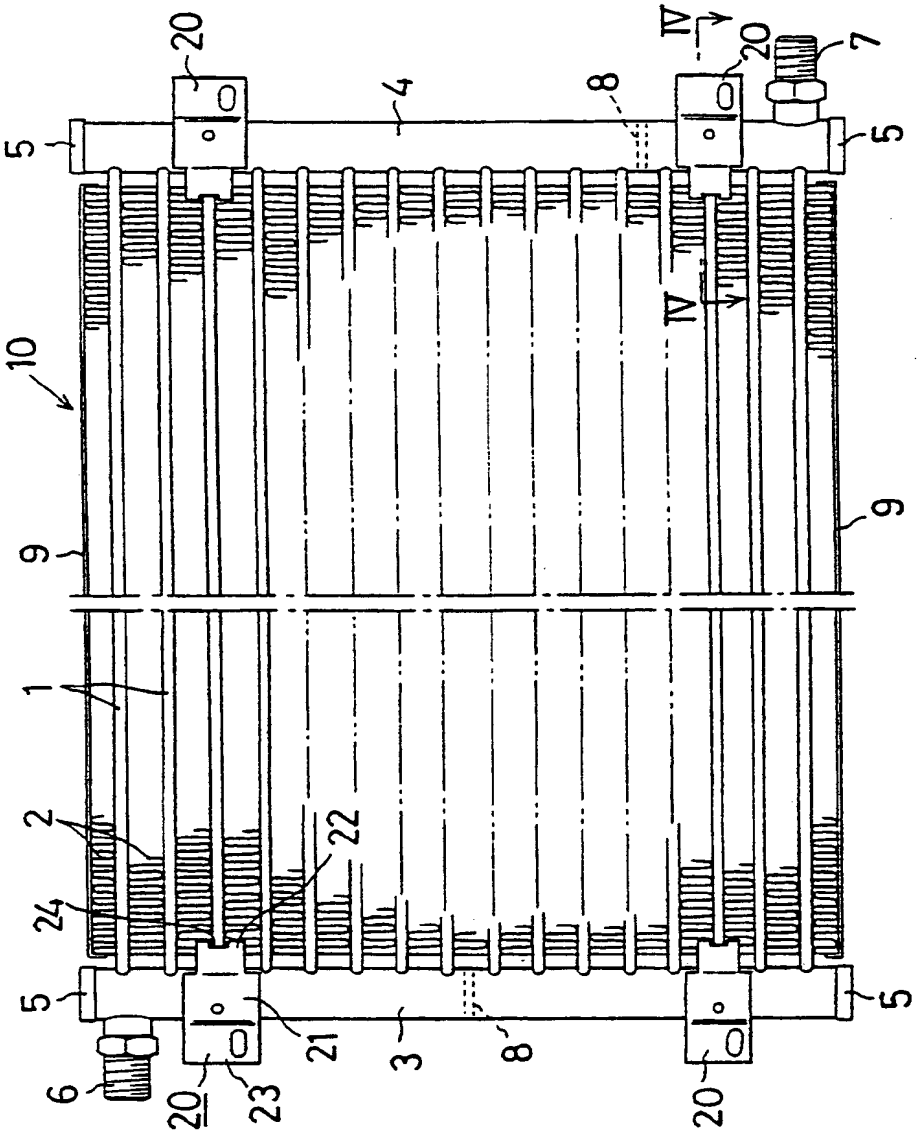


FIG. 1

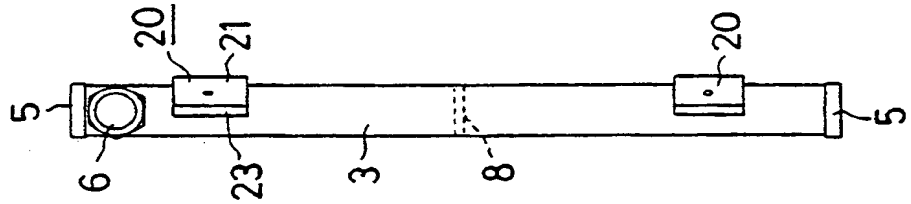
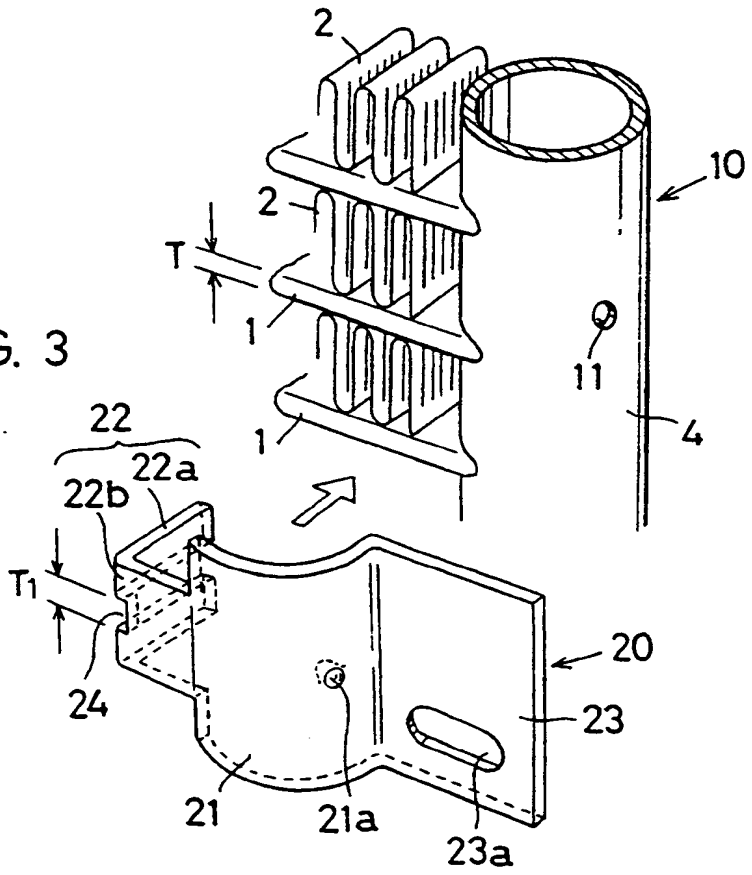


FIG. 2

FIG. 3


2
2
T
1
1
10
11
4
22
22a
22b
T1
24
20
23
21
21a
23a

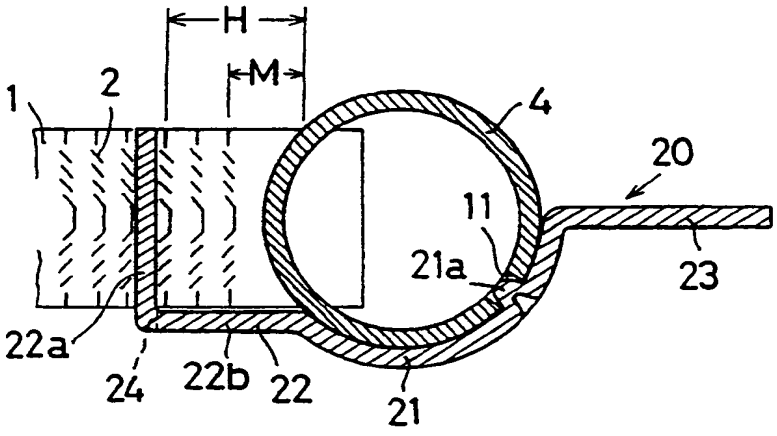

H
M
1
2
4
20
11
21a
23
22a
24
22b
22
21

FIG. 4

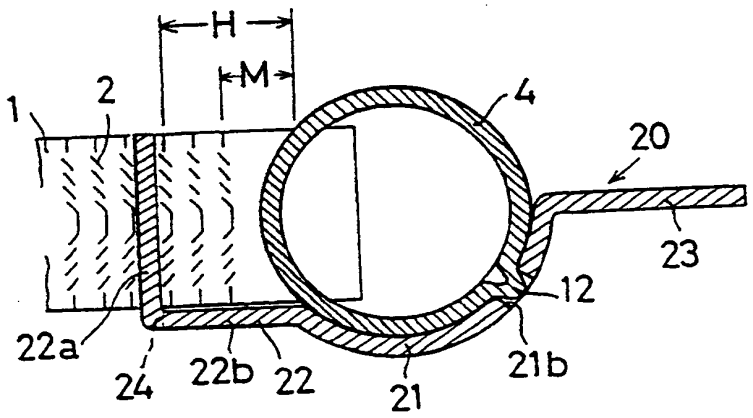


FIG. 5

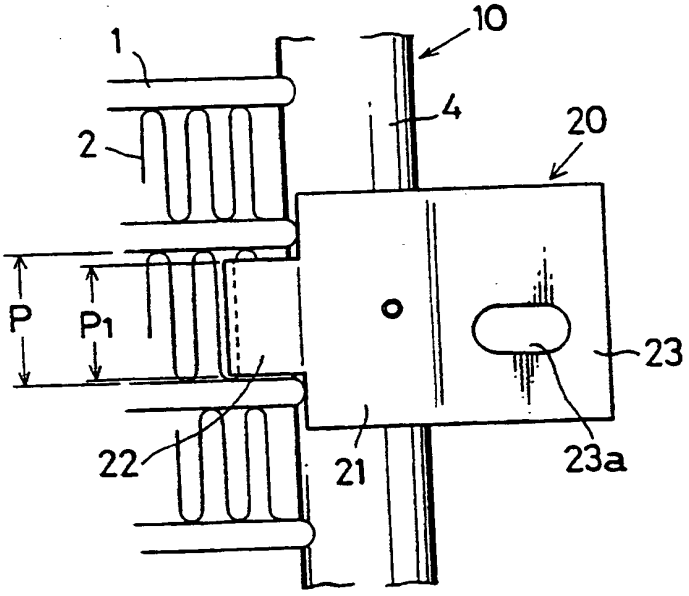


FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 30 0633

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-4 651 816 (STRUSS) * the whole document *	1	F 28 F 9/00 B 60 K 11/04
P,A	GB-A-2 223 091 (CALSONIC CORPORATION) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F 28 F
B 60 K

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	06 May 91	SMETS E.D.C.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same catagory
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention

E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document